



A Forecast of Lumber Demand

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By analyzing the major influences on lumber consumption in the past and projecting the trends into the future, the author forecasts the demand for the next building cycle (18 years). The peak of the cycle is expected in 1952 or 1953; the trough, 10 years later. A comparison of the central period of the cycle with that of the prewar cycle leads to the expectation of a 3.6-percent decrease in domestic lumber consumption, but a 5-percent increase in total lumber production.

PRIVATE forestry and much of public forestry are concerned with long-range prophecy regarding timber markets. Whether the process is conscious or not, all managers of timber forests must look into the future and make some assumptions about markets, for, if timber markets continue to dwindle, the need for sustained-yield or increased-yield forestry will dwindle correspondingly. Only if future markets are judged to be favorable can owners be expected to show interest in constructive timber-forestry practices.

Prophecy should be specific and inquire into the separate timber markets—lumber, veneer and plywood, pulpwood, poles, posts, ties, cooperage, shingles, fuelwood, or simply cellulose. Even if the total demand for timber does not change, if the demand for some products increases and the demand for others declines, vital questions of forest policy are involved.

In the following discussion, lumber is singled out for analysis. This is not so severe a limitation as may appear at first thought since lumber is by far the most important forest product and still represents well over half the total value yield. The method of study employed is that of analyzing each of the major influences on lumber consumption in the past, projecting the trends into the future, and synthesizing them into a single forecast of probable demand. The resulting forecast is limited to 18 years (one building cycle), since a longer forecast, however desirable, would stretch prophecy too far from the facts that may be reasonably weighed at this time.

POPULATION

The rate of population increase has been declining for some 25 years, and a stable popula-

tion estimated conservatively at 158 millions may be expected by 1980 (39). This is, obviously, a factor of great importance in explaining the historical decline in lumber consumption since 1906.²

Even more important than population increase has been the changing character of population. In 1880, 72 percent of the population was rural; by 1930, the percentage had dropped to 44. In 1880 there were 4.0 million farms, and in 1910, 6.4 million farms; but since 1910 the number of farms has been almost stationary (26).

These changes in population distribution have been significant because per-capita lumber consumption on the farm has been far greater than in urban areas. In nonbuilding forms of lumber use such as furniture, crating, and vehicles, urban per-capita consumption may be larger. In building, however, where consumption is most important, the statistics have been widely disparate. An average farm built before 1910 required 50,000 board feet of lumber (36); more recently, it has required some 30,000 feet. Thirty years ago, a nonfarm residential unit required an average of 17,400 feet of lumber; a new unit requires 14,200 feet (13). Nonresidential urban building has not been able to make up much of the difference, since it uses less than one-third of the lumber demanded for new dwellings.

Two aspects of population increase must be considered. One is the increase in total population; the other is the increase in number of families. The distinction must be made because the two trends are different and number of families has the more significant influence. It is number of families which largely controls volume of building, and building usually accounts

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²Lumber consumption rose rapidly throughout the nineteenth century, reached its all-time peak of 44.9 billion board feet in 1906, then dropped steadily, except for cyclical fluctuations, to a low of 14.5 billion feet in 1933. The downward plunge from 33.7 billion feet in 1929 was chiefly an outgrowth of the business depression, but regardless of this fact the secular decline in lumber consumption since 1906 is unmistakable.

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for two-thirds of total lumber consumption. Therefore, number of families should be given about 60 percent of the total weight assigned to population increase as a factor in lumber demand. This choice of weights makes some allowance for the fact that, in some classes of lumber demand, total population increase is more significant than increase in number of families.

In the decade 1920-30, the central period of the building cycle following World War I, population increased by 15.9 million persons (39) or 5.55 million families (46). Lumber consumption for the same period was 352.6 billion board feet. On a unit basis, then, lumber consumption was 22.176 billion feet per increase of one million persons, or 63.532 billion feet per increase of one million families.

Using these same ratios as a basis for forecasting and applying them to the approximate central period of the building cycle following World War II, 1950-60, the prospective population increase of only 7.8 million persons or 4.4 million families (39) indicates a considerable falling off in the demand for lumber amounting to 32.8 percent between the two building cycles.

Lumber demand is affected not only by population increases but also by population movements. Two types of movements are quite significant. One is the tendency of population to concentrate in relatively few areas, a process which results in abandonment in some areas, thus accelerating the rate of building for the country as a whole. The other significant trend is the diffusion of population from urban centers to the environs, which favors the construction of 1-family and 2-family dwellings instead of multi-family dwellings and thus tends to increase the demand for lumber. Both movements were well established in the 1920's (25, 18), and whether they will be more significant in the 1950's is wholly problematical. In the interest of conservatism, it is advisable not to give either trend weight in forecasting lumber demand.

LUMBER PRICES

The relative displacement of lumber by other materials has been observed for many years. Thelen estimated the total displacement by 1915 to aggregate at least 8 billion board feet (24). From 1919 to 1932 alone, the use of lumber continued its decline, dropping from 60 percent of the total of the 5 major building materials to 46 percent (37).

Part of the substitution for lumber, perhaps the larger part, was a result of the influence of prices. Prices of all building materials since 1860 have consistently risen faster than general prices, but lumber alone has moved upward much faster than its competitors. From 1860 to 1906, lumber prices increased 2.08 times as fast as prices of all building materials (5, 34, 41), which is even more startling when it is realized that lumber is included in all building materials. Initially, the price of lumber was low and large price increases were possible in the period of great national expansion and development without injuring demand. But the cumulative rises in relative prices had their effect; after 1906, further rises in lumber prices were met by increases in the use of competitive materials.

A statistically accurate measure of price elasticity of demand is not available, but some indication of what the index may be can be gained from a comparison of short-term reversals of trend in relative lumber consumption and prices (32, 33, 37). Three periods were analyzed, 1920-21, 1927-28, and 1930-32. The first indicated an index of elasticity of -2.0 ; the second, -1.0 ; the third, -0.5^3 . It would be safest to accept the last figure, which was obtained from the period recording the most decisive changes in consumption and prices.

In attempting to gauge relative lumber prices in the next building cycle, the experience of World War I is helpful. From 1915 all prices rose steeply to a peak in 1920, then declined abruptly. But after the initial decline, prices remained on a plateau higher than in the prewar period (32, 33). If the price index of lumber in 1915 is compared with the average for the war and postwar period (1916-38), a rise of 86 percent is indicated. For all building materials in the same period, the rise was 76 percent. Thus, lumber gained 10 percent in its relative price position.

The price pattern of World War II has resembled that of World War I. When prices drop or level off again, lumber may be expected to have gained relative to all building materials prices, and the gain will be at least 10 percent. As to additional rises in prices, an analysis of

³Price elasticity of demand is measured by the percentage change in the quantity demanded produced by a change in price of one percent. This ratio is expressed as a numerical index which is almost always negative, since the change in demand is in the opposite direction to change in price.

the determinants of lumber prices does not indicate that such rises are likely.⁴

Application of the expected relative increase in lumber-price levels, 10 percent, to the assumed index of demand elasticity, -0.5 , indicates a probable reduction in lumber consumption from the prewar building cycle of 5 percent.

INITIAL COSTS OF BUILDING

The principal building materials are not wholly competitive. There is a complementary relationship between them which makes the demand for each dependent upon the volume of building. It can be concluded, therefore, that the demand for lumber is influenced by the total costs of building as well as by the relative price of lumber.

Labor costs have a more uncertain relation to variations in building activity than have materials costs. Wage rates are comparable to those of other industries; therefore, if labor costs are higher in building, it is due to factors other than wage rates (7). So far as a forecast is concerned, trends in building-labor costs cannot be considered different from those in other industries.

Materials prices are the most important element in initial building costs (16). The fluctuations can be correlated with changes in the volume of building except in periods when other factors exert strong, contradictory influences (19).

Probable changes in postwar prices of building materials are not sufficient to affect a forecast of the volume of building. Price behavior during World War I resulted in a large gain for prices of all building materials over general prices, but more recent price behavior indicates a strong probability that building materials and all commodities will be in about the same relative position in the postwar period as in 1939.

COSTS OF BUILDING OWNERSHIP

Costs of ownership, like interest, taxes, insurance, maintenance, heating, and garbage collection, although considerable (23), can probably be neglected as potential modifiers of the volume of postwar building. The period of mortgage amortization, however, is a cost which is changing, with consequent effects on building activity.

Depreciation rates for houses have averaged about 40 years (10), but under the influence of

the Federal Housing Administration most mortgages will provide for amortization of less than 25 years and establish the latter period as the maximum for book depreciation of building (17). The effect on the investor will be to decrease his annual earnings for the period of mortgage payment by increasing annual amortization costs 60 percent. There will be, however, a shorter period until rents can be earned without deductions, so that the investor's probable attitude will be to consider the apparent cost increase equivalent to only half of 60 percent.

Amortization represents about 10 percent of the total costs of building ownership (23). Applying 30 percent to 10 percent indicates that the effect of the changing amortization rates in the next building cycle will be to increase the total costs of building by 3 percent. Assigning an index of elasticity of -1.0^5 to the anticipated cost rise, a probable decline of 3 percent in the cost of building is obtained. The proportional decline in consumption of building lumber should be the same. Recognizing, further, that building usually accounts for two-thirds of all lumber demand, the effect of the costs of building ownership in the postwar period will be to reduce the demand for all lumber by 2 percent.

LOCATION AND MIGRATION OF INDUSTRY

Paralleling population movements are similar trends of concentration and diffusion for industry, with similar effects on lumber demand. These trends have been well established for some decades (12), and there is little justification for supposing they will assume sufficiently greater importance in the postwar period than in the prewar period to require any modification of a forecast of lumber demand on this basis.

BUILDING CYCLES

Fluctuations in building activity largely determine fluctuations in lumber consumption. Short cycles in building average 4 years in length; they are associated closely with business activity but are much more severe than minor business cycles (17). Of far greater consequence are the major cycles in building which appear as sweeps of great height and depth and

⁵C. D. Long, in *Building Cycles and the Theory of Investment*, Princeton Univ. Press, Princeton, 1940, states that the demand for all buildings as a function of cost has to be close to unity because of the enormous part which building and associated expenditures comprise of national and individual income.

⁴This subject has been treated in some detail in the writer's Ph. D. dissertation.

last an average of 18 years (22, 45). These major cycles are usually quite distinct in pattern, particularly for residential building.

While the secular trend for total building has been upward, the secular trend of lumber consumption has been steeply downward. This need not be confusing since the proportion of lumber to all materials in building has constantly declined even though building construction remains the chief market for lumber. Ignoring the secular trends, however, the correspondence between building construction and lumber demand is found to be fairly close. Even the rises and declines in the short cycles of building check in most cases with the rises and declines of total lumber consumption. The notable exceptions have occurred in the two world wars when building was artificially restricted and great impetus given to lumber uses such as shipbuilding and crating.

Although the major building cycle is the chief determinant of the major cycle in lumber demand, it is not necessary to project an hypothetical building-cycle pattern into the postwar period to forecast the curve for total lumber consumption. It is possible to work directly with total lumber demand and project a curve into the postwar period which is based closely on the curve of demand in the prewar period and differs chiefly in that it provides for an expected 18-year cycle rather than the 15-year to 16-year cycle of the prewar period. The idealized pattern thus developed assumes that lumber demand will reach its peak in 7 to 8 years, about 1952 or 1953, and its trough in 1962 or 1963.

NATIONAL INCOME

National income is an index of the volume of business and industrial activity. As income increases, it results in a greater demand for the products of industry, including lumber.

Prospective national income in the postwar period is greater than the mere cyclical rise in the years following World War I would indicate. Although it is generally assumed that postwar national income will be over 100 billion dollars annually, not many forecasts of a more specific nature have been made. The editors of *Fortune Magazine* have made a detailed analysis of production capacity and have predicted for the year 194Q—"an economy with the foibles and habits of the American people retained but with most of the underproduction and unemploy-

ment removed"—a national output worth 165 billion dollars at 1943 prices (9).

The estimate of 165 billion dollars in 194Q compares almost fantastically with the national income in 1929, the peak year of the prewar building cycle. It is 59 percent greater than the 1929 peak, even when expressed in equivalent prices (104 billion dollars) (9). Since 194Q is not a peak year, the estimate might be raised. But to avoid excessive optimism from assuming too large an increase in national income, it may be wiser for the purpose of a forecast to retain the estimate of 59 percent unchanged.

Some knowledge of the income elasticity of lumber demand may be gained by observing the relations between family income and expenditures. A study by the National Resources Committee shows that as one progresses from low to high family-income brackets, housing expenditures increase slightly more than one-half as fast as income (38). This relationship should hold for housing-lumber demand, too, and it should not be far from expressing the relationship between all-building lumber demand and income. From an examination of the National Resources Committee data for other broad classes of consumer expenditure, the rate of increase in demand for other classes of lumber use is apparently less than one-half the rate of income increases (38). For all classes of lumber consumption, then, an index of $+0.5$, which indicates an increase in demand at half the rate of income increase, should approximate the actual relationship.

Applying an elasticity index of $+0.5$ to a predicted increase of 59 percent in national income, an expected increase in lumber consumption amounting to 29.5 percent is obtained.

CONSUMER PREFERENCES

Consumer preferences leading to lumber displacement in nonfarm residential building act through several processes. A change in the types of materials used in 1-family and 2-family dwelling units has been definitely established for several decades (14), and the expected continuance of the trend will lead to a decline in lumber consumption which is 1.7 percent of the total demand in the prewar period. Multifamily building has been moving toward fireproof construction (14) and, in expecting 10 percent of the new units to be frame, 30 percent masonry,

and 60 percent fireproof, a decline in lumber consumption of 0.5 percent is visualized. Little change of size has been noted within the 1-family and 2-family dwelling group, but the trend in multifamily units leads to the expectation of a 15-percent decline in size (4, 15) and a consequent fall in the demand for lumber of 0.4 percent. A fourth trend, that leading to a change from 1-family and 2-family building to multifamily construction, now seems to have reached a state of equilibrium (31), and no allowance for change in lumber demand is required.

In urban nonresidential building, lumber displacement has also taken place. From 1919 to 1931 alone, lumber dropped from 25 to 19 percent of the total building materials used (37). However, displacement has already gone so far that no adjustments are needed in the forecast of lumber demand.

In farm construction there has been a trend toward lumber displacement (13, 24), and allowance for it must be made in the forecast. A nominal figure of 1 percent may be assigned to the expected decline in total lumber consumption from the building cycle following World War I. Perhaps this is not enough, especially in view of the covetous glances cast by producers of new materials at the farm market (8). Nevertheless, until substitution becomes more decisive, it will be wiser to estimate the probable decline in use of farm lumber at a low figure.

Types of construction other than building have not used much lumber (27). The use of other construction materials has grown, sometimes tremendously, but this does not constitute lumber displacement. Such displacement of lumber in nonbuilding construction as has taken place belongs chiefly to an earlier period (24). Further declines will probably not be important.

Among the nonconstruction forms of lumber use, a further decline may be expected in furniture. It is presumed that the trends established since World War I (20) will continue without much change into the cycle following World War II. Accordingly, the use of wood for household furniture may be expected to decline between the two cycles from 93 percent of the total to 78 percent, and the use of wood for furniture in offices, stores, and public buildings will decline from 67 percent of the total to 27 percent (allowing for a slight tapering off of the

trend away from wood in this category). On these bases, the estimate of decline in lumber consumption is 0.6 percent.

Other important types of nonconstruction use, such as vehicles, railroad cars, and shipbuilding, have already witnessed their major displacements of lumber by other materials (20, 24, 28, 30), and further significant displacements need not be anticipated. As for the recent phenomenal growth of container uses of lumber (43), it must be remembered that this is a war phenomenon which should not guide postwar estimates too heavily. Brisk trading may continue the use of lumber containers at a high level, but in looking ahead 18 years it may be safer not to modify estimates of lumber demand.

The many new developments in lumber utilization are heartening to lumber producers, but it should be realized that other materials are not standing by idly. They are also recording marked advances, and if the lumber industry is interested in furthering its competitive position, it must adopt as strenuous a program for organization, research, and advertising, as is true of its competitors. This would mean a larger promotional effort than has been put forth by the lumber industry in the past.

Until it becomes more evident that the lumber industry can counteract the gains of competitive materials over lumber, one should not grasp too strongly at the assumption of a halt in lumber decline owing to consumer preferences. At least the analysis which indicates a prospective decline in lumber consumption of 4.2 percent between the central decades of the building cycles following World War I and World War II should not be waved aside. In fact, increase of this estimate to 4.4 percent, to allow for declines among minor uses of lumber, is warranted.

• GOVERNMENT AND BUILDING CYCLES

It is obvious that much lumber has been required for the huge public-works programs of prewar years. Nevertheless, lumber has been a smaller item than might have been supposed. Lumber represented 4.5 percent of the total cost of all construction in 1929, but it represented only 3.3 percent of the cost of P.W.A.-financed construction in the period 1933-38 and only 1.9 percent of the cost of regular federal construction in 1934-38 (11). The explanation lies primarily in the types of construction performed

by public and private agencies. Private construction concentrates on commercial and residential buildings, while public construction consists chiefly of highways, sewers, bridges, and dams as well as nonresidential buildings.

Lumber and timber used on federally financed projects comprised only 3 percent of total lumber and timber production in the second half of 1933. But in the period 1934-38, with the great expansion in public construction activities, federally financed orders averaged 10 percent of the total production (11). This illustrates a definite influence of public enterprise tending to cushion the decline of total lumber demand in the trough and low levels of the major business cycle.

Regarding the postwar period, it does not appear that more allowance should be made for increased lumber consumption in the trough of the building cycle because of public construction than in the prewar building cycle. The trend toward increased governmental participation in the national economy may have reached a peak, at least temporarily. Evidences of a political reaction are noticeable and, in assuming the role of prophet, one can justifiably suppose that peacetime activity of government will be held at a low level until another great depression forces the advent of a second New Deal.

GOVERNMENT AND VOLUME OF BUILDING

Governmental efforts to advance low-cost housing have great merit from various social and economic viewpoints. Here, however, the problem is whether public policies have any influence in increasing the volume of building and, consequently, the demand for lumber. Emphasis is usually placed on providing a larger proportion of new houses for the lower income groups, but only in so far as this involves a shorter useful life and replacement for all housing does it indicate an increased volume of building.

Some skepticism has been expressed regarding the capacity of government to increase the long-term volume of building (14). Nevertheless, although some of the evidence does point to limited influence as an historical fact (2, 47), other evidence can be marshaled to show that government can affect the long-term volume of building quite strongly. For example, large-scale construction methods which have already effected savings on specific projects amounting to 13 to 40 percent over cost of comparable units built by

traditional methods (1, 6, 16), when related to a cost elasticity of demand in the vicinity of unity, indicate a powerful influence that government could exert on the volume of building. Furthermore, since income increases are a great stimulant to building and since public policies can affect incomes, it follows that government can influence the volume of building through its policies in distributing and increasing income.

Of course, there is a considerable difference between pointing out the influence that could be exerted by government to increase the volume of building and evaluating the actual influence exerted in the past or the influence that is likely to be exerted in the near future. For the latter purpose, skepticism regarding increased influence is justified. A forecast of future lumber demand may overlook the prospective role of government policies.

DEPRECIATION AND OBSOLESCENCE OF URBAN BUILDINGS

Replacement of buildings in the past has not been greatly affected by age and physical depreciation, since more than 75 percent of the houses in the United States are less than 50 years old (44). But this condition is changing, and as the average age of buildings increases, the need for replacement of buildings will also increase. What the probable average life of dwellings will be is subject to dispute. While many experts hold to the idea of durable dwelling units as a stable factor in the design for living, many other housing experts believe that one of the important factors in postwar housing will be the short-term low-cost home that will be treated as a commodity rather than real property (21). Hallauer has estimated probable average life at 80 years and has offered good reasons for his contention (14).

A study of urban residential buildings, published in 1938, lists 2 percent of the total as unfit for use and requiring total replacement, 45 percent requiring minor repairs, and 14 percent requiring major repairs (44). This is a backlog of requirements, an addition to the 385,000 new units required each year just to take care of the increases in urban families (3, 42), and the 322,000 dwelling units to be replaced every year through depreciation (accepting 80 years as the probable average life of dwellings).

Because of the large gap existing between

average age of buildings and the age at which replacement becomes absolutely necessary, the factor of depreciation should be minimized for the bulk of housing as an influence increasing the volume of building in the postwar period. The increasing age of structures may make the repair and replacement of buildings more responsive to other influences such as costs and income, but it does not appear that such influence of age can be judged sufficiently important per se to alter a forecast of lumber demand which is limited to 18 years.

Only the dwellings estimated to be entirely unfit for use and in need of major repairs should be considered in the postwar lumber forecast. Application of the percentages given in the 1938 study to Chawner's estimate of 25,779,000 dwelling units in 1938 (3) indicates some 500,000 units entirely unfit for use and 3,500,000 units in need of major repairs. This backlog of needed replacements has increased throughout the war. The first total can be estimated conservatively at 750,000; the second, at 4,000,000.

The assumption that the backlog of 750,000 dwelling units unfit for use will be replaced within the postwar building cycle is not unreasonable. Applying to this figure an average of 14,200 board feet of lumber per unit (14), a total demand for 10.6 billion feet of lumber is obtained. The backlog of major repairs, presumably, will also be taken care of within the next building cycle. Using an estimate of 500 board feet per major repair and applying it to 4,000,000 units, a demand for 2 billion feet is indicated.

In addition to the backlog of 12.6 billion feet of lumber for housing, a similar backlog exists for urban structures other than housing, although in smaller volume. Assuming the lumber-use ratio of nonhousing to housing can serve as a basis of estimate, an accumulated need for some 1.9 billion feet is shown, which raises the total for all urban building to 14.5 billion feet. Expressed as a percentage of total lumber consumption in the prewar building cycle, the prospective increase for the next cycle is 4.0 percent.

DEPRECIATION AND OBSOLESCENCE OF FARM BUILDINGS

The Farm Housing Survey of 1934 revealed how poor was the general state of repair of American farm homes. Some 15 million major repairs were needed (35), or an average of more

than 2 per house. A supplementary survey showed 697,000 farm houses to be beyond repair and in urgent need of replacement. Furthermore, it has been estimated that about 3,000,000 new service buildings are needed and that there is an average annual need for about 700,000 for replacement (40).

As in the case of urban building, caution is necessary in referring to the apparent accumulated need for farm structures as an index of prospective building. Depreciation of buildings can be extended a little further before replacement is made. But there is this major difference. Farm structures are, on the average, in far worse condition than urban buildings. Replacement and repairs cannot be deferred indefinitely, and certainly a large volume of the accumulated need for building must be taken care of within the next building cycle. Knowledge of the enormous backlog of farm construction and optimism over the farmers' financial condition has led agricultural engineers to estimate a potential farm-construction market for the first decade of peace ranging from 500 million to 2 billion dollars annually. This may be compared with an annual depreciation of about 400 million dollars (8).

The 697,000 farmhouses shown by the 1934 Farm Housing Survey to be in urgent need of replacement had grown to 1,000,000 in 1940 (40). Recognizing the restrictions in wartime building, the present estimate should be at least 1,250,000. The latter total indicates probable increased new building over the building cycle following World War I. The estimate can be broadened to include other farm building as well as houses, since substandard structures usually accompany substandard farm houses. Calculations can be based on 20 M board feet of lumber per average farm, although a deduction of 4 M feet to approximate the amount salvaged from the demolished buildings is more reasonable (13). The total increased lumber demand calculated is 20 billion feet.

The estimate of the backlog of urgent lumber repairs likely to be replaced during the next building cycle is placed at 5 billion feet, which raises the forecast of increased farm lumber demand to 25 billion feet. Expressed as a percentage of total lumber consumption in the building cycle following World War I, the prospective increase is 6.9 percent.

INTERNATIONAL TRADE⁶

Exports and imports of lumber have little effect on domestic lumber demand. Such influence as they have exerted has occurred largely through modification of domestic lumber prices. Since the price influence has not been large, except for a few species in localized border areas, the influence on domestic demand could not be very significant. However, considerable interest attaches to the prospective role of the international lumber trade because the trade does have a significant influence on domestic lumber production.

The historical parallelism between lumber imports, most of which come from Canada, and lumber production has been striking. Because of this fact, it is assumed that the average ratio of imports to production in the building cycle following World War I, 4.3 percent, will also apply to the cycle following World War II. On this assumption, imports can be forecasted by applying 4.1 percent to the sum of domestic lumber demand and exports in each year.⁷

A forecast of lumber exports cannot be made so simply. In part it can be oriented to the past, but to a large degree it must refer to conditions created by the war. The peak of 3.4 billion board feet reached in 1928 does not represent the probable peak of postwar years, since the world's upheaval is much greater than it was in World War I and the consequent effect on the world's lumber trade will prove to be proportionately greater.

Lumber exports for the 18-year forecast period have been estimated at 76 billion feet. This total has been made up from the following calculations: 9 billion feet to Great Britain (much dependent upon preferential tariff treatment accorded to the dominions), 23 billion feet to the European continent, 15 billion to Japan, 13 billion to China, 9 billion to Latin America, and 7 billion to the rest of the world.

Exports will be heaviest in the first postwar decade and then fall off as reconstruction in the

devastated areas is accomplished. Hence, the pattern of major cyclical fluctuation adopted for domestic lumber demand should serve as a rough indication of the major cyclical fluctuation in lumber exports.

CONCLUSION

The reference point for forecasting lumber demand is consumption in the building cycle following World War I, which aggregated 504.4 billion board feet of lumber. By analyzing the trends for each of the influences on lumber demand and projecting them into the future, it has been possible to estimate the weight of each of the influences in raising or lowering lumber demand in the next building cycle. By this method, a series of estimates was obtained whose sum indicates the prospective change in lumber consumption from the total of the building cycle following World War I.

There are other influences whose effect may be considerable, but Table 1 includes only those influences whose weight is believed to be changing and which will have a measurably different effect on lumber consumption from that exerted in the building cycle following World War I. Thus, government policy, geographic movements of population and industry, consumer preferences in important categories of lumber use such as urban nonresidential building, nonbuilding construction, vehicles, railroad cars, shipbuilding, and containers, and international trade, have all been omitted, even though their influence is considerable.

The prospective net change indicated by the sum of all the estimates is a decline of 3.6 percent in total lumber demand.

TABLE 1.—PROSPECTIVE CHANGES IN TOTAL LUMBER DEMAND RESULTING FROM CHANGES IN MAJOR INFLUENCES

Influence	Percentage change	
Population	—	32.8
Prices		
Lumber	—	5.0
Building costs	—	2.0
National income	+ 29.5	
Consumer preferences		
Nonfarm residential building	—	2.6
Farm construction	—	1.0
Furniture	—	0.6
Depreciation and obsolescence		
Urban	+ 4.0	
Rural	+ 6.9	
Total	+ 40.4	— 44.0
Net change		— 3.6

⁶World imports and exports of lumber and their effects upon domestic consumption and production have been analyzed in considerable detail in the writer's Ph.D. dissertation.

⁷Where domestic lumber demand=C, exports=E, production=P, and imports=I, or 43 percent of production, C+E-I=P; C+E=P+I; C+E=1.043 P;

$\frac{C+E}{1.043} = P$; and since, $I=.043 P$, $I=\frac{.043 (C+E)}{1.043}$
 $=.041 (C+E)$.

Some question regarding the reliability of the final answer may be raised because the independence of the component estimates is not complete. Nevertheless, it is believed that no important distortion appears in the estimate of total decline.

Obviously, the trend in national income is partly determined by the trend in population increase, and the demand of population for lumber is conditioned by the amount of national income. If the effects of population and national income were exerted in the same direction, i.e., either in increasing or decreasing lumber consumption, there would definitely be a problem of untangling the effects to avoid duplication in the estimates. But the actual effects (between the two postwar building cycles) are in opposite directions with similar slopes, and the practical result is largely to nullify the interdependency of the influences.

An objection may also be leveled at the supposed confusion between the estimates for prices and consumer preferences, but actually the estimates are fairly independent. In the analysis of the role of consumer preferences, trends in displacement beginning with World War I or not earlier than 1913 were studied. During this period, the ratio of lumber prices to prices of all building materials went through some sharp cyclical movements, but the trend line was nearly horizontal, showing only a minor upward divergence in lumber prices from prices of all building materials. It is obvious, then, that prices could have had little effect on the estimate of lumber displacement assigned to consumer preferences. In the estimate for prices, the index of price elasticity of demand chosen was based on the behavior of relative prices and relative consumption in short periods consisting of no more than 3 years. This method largely excludes the influence of consumer preferences because the effects of such preferences between lumber and other materials, independent of price considerations, are not felt as rapid fluctuations within periods of a few years.

Before applying the prospective decline of 3.6 percent to lumber consumption in the building cycle following World War I, a correction is necessary to adjust the 16-year cycle to a prospective 18-year cycle. This is done by expanding the total consumption of 504.4 billion board feet for the 16-year cycle to include two additional average years, which makes a total of 567.4

billion feet. Applying the net reduction of 3.6 percent, the prospective domestic lumber demand in the 18-year postwar building cycle is calculated to be 547.0 billion feet.

The total estimate of lumber demand is fitted to a curve of major cyclical fluctuations in Table 2. The forecasted cycle begins with 1946, reaches its peak in 1953, and declines to its lowest point in 1963. By way of contrast, the building cycle following World War I began with an annual consumption of 32.0 billion board feet, reached a peak of 39.7 billion feet in 6 years, and declined to a low of 14.5 billion feet in 16 years.

The forecast of domestic lumber demand is complete, but it can be modified by the estimates of exports and imports to present a more complete picture of total lumber production. In Table 3 the various estimates are brought together. Although the forecasts provide for a slight decrease in domestic lumber consumption, postwar net exports are estimated at a considerably higher level than in the building cycle following World War I, with the result that future production will be at a higher level too. Production in the cycle following World War I averaged 31.5 billion board feet a year; the estimate for the next cycle averages 33.2 billion feet a year, a prospective increase of 5 percent.

TABLE 2.—ESTIMATED INDEX NUMBERS AND LUMBER DEMAND IN 18-YEAR PERIOD FOLLOWING WORLD WAR II

Years from end of war	Index number ¹	Lumber demand billion bd. ft.
1	117	35.6
2	119	36.1
3	121	36.7
4	123	37.4
5	125	38.0
6	127	38.6
7	129	39.2
8	129	39.2
9	126	38.3
10	121	36.7
11	110	33.5
12	98	29.8
13	83	25.2
14	68	20.7
15	58	17.6
16	50	15.2
17	48	14.6
18	48	14.6
Total		547.0

¹Average 18 years=100.

TABLE 3.—FORECAST OF DOMESTIC DEMAND, EXPORTS, IMPORTS, AND PRODUCTION OF LUMBER IN 18-YEAR PERIOD FOLLOWING WORLD WAR II

Years from end of war	Domestic lumber demand	Lumber exports	Lumber imports	Lumber production
		Billion board feet		
1	35.6	4.9	1.7	38.8
2	36.1	5.0	1.7	39.4
3	36.7	5.1	1.7	40.1
4	37.4	5.2	1.7	40.9
5	38.0	5.3	1.8	41.5
6	38.6	5.4	1.8	42.2
7	39.2	5.5	1.8	42.9
8	39.2	5.5	1.8	42.9
9	38.3	5.4	1.8	41.9
10	36.7	5.1	1.7	40.1
11	33.5	4.6	1.6	36.5
12	29.8	4.1	1.4	32.5
13	25.2	3.5	1.2	27.5
14	20.7	2.9	1.0	22.6
15	17.6	2.4	0.8	19.2
16	15.2	2.1	0.7	16.6
17	14.6	2.0	0.7	15.9
18	14.6	2.0	0.7	15.9
Total	547.0	76.0	25.6	597.4

This is not a final blueprint. It is a summary of possibilities derived from an analysis of many trends, and when any of the basic assumptions are changed corresponding corrections must be made in the estimates. The forecast is conservative, both in its consideration of increases and decreases in lumber demand. The postwar world may usher in an era of glittering houses of radically different design and new materials and low cost. Perhaps, as say some prophets, wood as lumber is finished, and we stand on the threshold of an age of plastics and light metals, or perhaps a host of other revolutionary possibilities. But in the forecast presented for an 18-year building cycle, the attempt has been made to steer a middle course, to rely heavily on the trends well established, and to place faith in progressive evolutionary changes rather than in radical innovations. The result does not indicate that lumber is finished.

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